Clinical use of an extracorporeal membrane oxygenator (ECMO) in neonatal pulmonary failure.

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Thanks to the improvement in respirator care the mortality of newborns with respiratory insufficiency has decreased markedly during the last decade. Nevertheless, the number of newborn infants who die of pulmonary failure inspite of maximal efforts is still large enough so that additional means of assisting respiratory gas exchange must be found. Extracorporeal membrane oxygenation has been evaluated for this purpose (3).

Membrane oxygenators cause less hemolysis than bubble oxygenators and thus can be used for several days instead of only hours. Such a temporary artificial lung should be an appropriate means of support for newborns whose respiratory failure is due to a reversible disease e.g. meconium aspiration (MAS), persistent fetal circulation (PFC), and respiratory distress syndrome (RDS).

The extracorporeal circuit has a volume of 350 ml and is primed with blood. For venoarterial (VA) and venovenous (VV) ECMO blood is drained from the right atrium by gravity through a catheter in the the right internal jugular vein. A roller pump pumps the blood through a Kolobow Sci-Med membrane oxygenator and a heat exchanger back into the patient via the right common carotid artery for VA ECMO and to a femoral vein for VV ECMO (1). A mixture of 95% O_2 und 5% CO_2 provides the necessary gas gradients for the membrane lung. The blood is heparinized and the activated clotting time is checked frequently. Consumption thrombocytopenis is corrected with platelet transfusions. Medications and parenteral nutrition solutions are given via the ECMO circuit. The patient remains intubated on a ventilator with low pressure, rate, and O_2 settings. A daily trial without ECMO informs about any improvement in lung function.

Patients are selected for ECMO if they have not responded to maximal ventilatory, medical, and surgical means. During the first day of life the Neonatal Pulmonary Insufficiency Index (NPII) (4) - a scoring system based on pH and O_2 requirements - of over 80% chance of dying is an indication. Major malformations, birthweight under 1000 grams, and intraventricular hemorrhage (IVH) are contraindications.

During the development of the technique at the University of California-Irvine from 1973 to 1980 22 of 40 moribund infants survived (2). In 1980 the project was moved tho the University of Michigan where a further 20

patients have been placed on ECMO, with 13 survivors:

	N	survived
MAS	6	6
RDS	8	2
PFC	4	3
CHD	2	1
Total	20	13
Viable*)	18	13

*) if 2 patients with non-survivable anomalies are excluded:
- 1 renal dysplasia
- 1 CHD: single ventric.

Thus far our experience indicates that ECMO is much more successful in term infants with MAS and PFC. Prematures with RDS and birthweights under 2000 g appear to benefit less from ECMO, primarily because of IVH, the main complication in this group. Other problems include hemothorax, membrane failure, transient renal failure, and seizures. The latter may, howver, have been caused by the preceding birth asphyxia in infants with MAS. The ligature of the right carotid artery has caused no ill effects as determined by clinical, ultrasound, and Doppler examinations. All infants are followed up as to their physical and neurological development. Preliminary evidence from the older survivors shows them to be similar to non-ECMO survivors of severe neonatal illness.

ECMO requires major technical and personnel resources. A lengthy training period for a special team in an animal perfusion laboratory is necessary. Therefore we are now evaluating its efficacy and cost effectiveness in a randomized controlled study before recommending a more general clinical introduction of ECMO.

Literature:

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